

DOCUMENT RESUME

07666 - [C30(8170)]

Better Water Management and Conservation Possible, but Constraints Need To Be Overcome. CED-79-1; B-114885. October 31, 1978. 30 pp.

Report to Cecil D. Andrus, Department of the Interior; by Henry Eschwege, Director, Community and Economic Development Div.

Issue Area: Water and Water Related Programs: Water conservation and reuse programs (2504).

Contact: Community and Economic Development Div.

Budget Function: Natural Resources, Environment, and Energy: Water Resources and Power (301); Natural Resources, Environment, and Energy: Pollution Control and Abatement (304); Natural Resources, Environment, and Energy: Energy (305).

Organization Concerned: Bureau of Reclamation.

Congressional Relevance: House Committee on Interior and Insular Affairs; Senate Committee on Energy and Natural Resources.

Authority: Rehabilitation and Betterment Act of 1949, as amended (43 U.S.C. 504). Small Reclamation Projects Act of 1956, as amended (43 U.S.C. 422a). Distribution Systems Loans Act, as amended (43 U.S.C. 421a). 43 U.S.C. 372. 43 U.S.C. 383. Fox v. Ickes, 137 F.2d 30 (D.C. Cir. 1943).

Previous GAO reports identified improvements needed in the Bureau of Reclamation's implementation of agricultural water management and conservation practices, but it was recognized that institutional and legal constraints would affect the Bureau's ability to implement recommended changes. In 1977, the Bureau began a study to accelerate the identification of its projects and those of the Bureau of Indian Affairs in which opportunities existed to make better use of water supplies. Findings/Conclusions: The study does not deal adequately with constraints and, therefore, has limitations as a basis for ranking projects. The following categories of constraints impede efforts to promote better water management and conservation: the legal right to water saved by irrigators, high cost and repayment requirements of improving irrigation efficiencies, adverse effects on other water uses due to water-saving practices, rights of irrigators under long-term contracts which do not provide for adjustments of water rates and quantities, and lack of data on the nature and extent of the Federal role for achieving irrigation efficiencies. Water banking, the temporary transfer of a user's right to unneeded water to an intermediary who would make it available to a user who needs it, can overcome some major constraints to carrying out improved water use practices. Recommendations: The Bureau of Reclamation should analyze and seek solutions to constraints in its study efforts and examine the following potential solutions for overcoming constraints: water banking, consideration of basinwide benefits resulting from improving irrigation systems

in its loan determinations, and improvement of access to contract terms and development of conservation-oriented standard contract language. The resources committed to these examinations and to the Bureau's studies should be based on the results of a study by the Interagency Task Force on Irrigation Efficiencies.
(HTW)

REPORT BY THE U.S.

General Accounting Office

Better Water Management And Conservation Possible--But Constraints Need To Be Overcome

The Bureau of Reclamation should examine water banking (a temporary transfer of water rights) and two other potential solutions for achieving better water management and conservation. Reclamation studies have not resulted in improvements being implemented nor do they deal with constraints.

GAO recommendations should help Reclamation put the President's water policy initiatives into action.





UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

COMMUNITY AND ECONOMIC
DEVELOPMENT DIVISION

B-114885

The Honorable Cecil D. Andrus
The Secretary of the Interior

Dear Mr. Secretary:

This report is the fifth of a series concerning the Bureau of Reclamation's efforts to promote better water management and conservation. It discusses ways to overcome constraints to achieving irrigation efficiencies and should help implement the President's water policy initiatives announced in June 1978.

Our report contains recommendations to you on pages 19 and 30. These recommendations were discussed informally with the Office of the Assistant Secretary of the Interior for Land and Water and with the Assistant Commissioner of the Bureau of Reclamation for Planning and Operations and his staff. Their comments are included in the report where appropriate.

As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Operations not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report today to the four Committees to set in motion the requirements of section 236. Copies are also being sent to the legislative committees of the House and Senate interested in water resources; the Director, Office of Management and Budget; the Secretary of Agriculture; the Administrator, Environmental Protection Agency; and the Director, Water Resources Council.

Sincerely yours,

A handwritten signature in cursive script that reads "Henry Eschwege".

Henry Eschwege
Director

D I G E S T

Are the Bureau of Reclamation's existing projects still responsive to today's needs and changing values? Should they be modified by minor structural changes or by nonstructural alternatives to make better use of existing water supplies? Reclamation has undertaken a series of studies to seek answers to these questions.

Many of the same potential solutions or alternatives are repeatedly examined. However, little has been accomplished through these efforts in two regions covered by GAO's review because Reclamation did not seek solutions to constraints. (See p. 7.)

The problems are continuous. In 1977 Reclamation began a new study to accelerate the identification of its projects and those of the Bureau of Indian Affairs where there are opportunities to make better use of existing water supplies. Because this effort does not deal adequately with constraints, GAO cautions against using it as a basis for ranking projects for future study. (See p. 16.)

The following five major categories of constraints impede Reclamation efforts to promote better water management and conservation:

- The legal right to water saved by irrigators. (See p. 11.)
- High cost and repayment requirements of improving irrigation efficiencies. (See p. 12.)
- Adverse effects on other water users, such as reduction in return flows used as water supplies by ground water pumpers and downstream irrigators, due to water saving practices. (See p. 13.)
- Rights of irrigators under long-term contracts which do not provide for adjustments of water rates and quantities. (See p. 14.)

--Lack of data on the nature and extent of the Federal role for achieving irrigation efficiencies. (See p. 15.)

GAO recommends that the Bureau of Reclamation analyze and seek solutions to identified constraints in its study efforts. (See p. 19.) Also, Reclamation should examine the following potential solutions for overcoming constraints impeding improved water use practices:

--Water banking. (See p. 20.)

--Consideration of basinwide benefits resulting from improving irrigation systems in Reclamation loan determinations for such improvements. (See p. 25.)

--Improvement of access to contract terms and development of conservation-oriented standard contract language. (See p. 26.)

Water banking is a temporary transfer of a user's right to unneeded water to an intermediary or broker who would in turn make the water available for withdrawal or sale to a user who needs it. Water banking can overcome major constraints to carrying out improved water use practices (such as legal rights to water saved, adverse effects on other water users, and cost constraints). The other potential solutions GAO identified have similar benefits.

GAO also recommends that the amount of resources committed to the examinations it is recommending and to Reclamation's studies of irrigation water management and conservation be based on the results of a study by the Interagency Task Force on Irrigation Efficiencies. This task force, if it accomplishes its goals, will recommend appropriate Federal objectives, policies, agency roles, and action programs to deal with inefficient irrigation systems. Thus far, a June 1978 draft report by the task force's Technical Work Group contains information on the overall significance of the irrigation efficiency problem but does not adequately address the basic causes and the applicable Federal role. (See p. 27.)

GAO believes that its recommendations will help Reclamation implement the conservation initiatives announced on June 6, 1978, by the President. (See p. i.)

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CHAPTER 1

INTRODUCTION

On June 6, 1978, the President announced his water policy, which, among other things, is designed to provide a new, national emphasis on water conservation. He said that this new policy resulted from a comprehensive review which showed that water conservation had not been addressed nationally even though the Nation has pressing water supply problems which may get worse in the future.

The President identified specific initiatives for increasing the emphasis on conservation in Federal water resources programs, including the following items affecting the Department of the Interior and its primary water resources agency, the Bureau of Reclamation:

- Provide technical assistance to farmers and urban dwellers, showing how to conserve water through existing programs.
- Require development of water conservation programs as a condition of contracts for storing or delivering municipal and industrial water supplies from Federal projects.
- Encourage water conservation in agricultural assistance programs which affect water consumption in water-short areas.
- Examine programs and policies so that appropriate measures to increase water conservation and reuse can be implemented.
- Include provisions in new and renegotiated contracts for recalculating and renegotiating water rates every 5 years instead of 40 years.
- Add provisions, under existing authority, to recover operations and maintenance costs when existing contracts are renegotiated.
- More precisely calculate and implement the ability-to-pay provision in existing law which governs recovery of a portion of the Federal cost of constructing the project.
- Prepare legislation to allow States the option of requiring prices higher than the actual Federal costs for municipal and industrial water supplies from Federal projects so as to promote water conservation.

The President also said that none of the initiatives would impose any new Federal regulatory programs for water management.

On July 12, 1978, directives were sent to the pertinent Federal agencies, requesting that actions be started to carry out the initiatives and establishing a timetable for completing the necessary actions.

OUR PRIOR REPORTS, AGENCY ACTIONS,
AND RELATIONSHIP TO CURRENT REPORT

Since 1975 we issued four reports concerning the need for the Bureau of Reclamation and other Federal agencies to promote better water management and conservation. Many of the recommendations we made are still under study, and the eventual action should have a large impact on the way that the President's water conservation initiatives are implemented.

For example, in May 1975 we reported 1/ that improvements were needed in the procedures and practices for determining irrigators' ability to pay the Federal cost of a water resources project allocated to irrigation. We found that irrigators' ability to pay is determined by ascertaining the estimated difference in farmers' income with and without an irrigation project and involves many subjective evaluations--each of which can substantially affect the amounts determined to be available for repayment. We recommended that Reclamation develop and implement (1) uniform guidelines for more precisely calculating the irrigators' ability to pay and (2) provisions in future contracts for periodically redetermining irrigators' ability to pay and the resulting irrigation repayment rates. Both these recommendations have been included in the President's water conservation initiatives because it is believed that a direct relationship exists between the rate of water use and the price paid for water.

In two reports 2/ issued in June 1976 and September 1977, we identified many improvements needed in Reclamation's

1/"More Effective Procedures Are Needed for Establishing Payment Terms and Development Periods for Irrigation Projects," (RED-75-372, May 23, 1975).

2/"Better Federal Coordination Needed To Promote More Efficient Farm Irrigation," (RED-76-116, June 22, 1976); "More and Better Uses Could Be Made of Billions of Gallons of Water by Improving Irrigation Delivery Systems," (CED-77-117, Sept. 2, 1977).

implementation of improved agricultural water management and conservation practices and made recommendations to the Secretaries of the Interior and Agriculture and the Administrator of the Environmental Protection Agency which, if properly implemented, should (1) determine the extent and causes of overirrigation, (2) identify ways to improve inefficient irrigation delivery systems, and (3) determine the role the Government should play in solving related problems. These agencies have established a task force under the lead of the Department of the Interior to deal with these matters; they plan to issue a final report by May 1979. Presumably, this report will have a substantial effect on those presidential initiatives concerning Federal programs for promoting agricultural water conservation.

Our latest report, issued in April 1978, discussed Reclamation and other Federal efforts to promote efficient municipal and industrial water use. ^{1/} We recommended that Reclamation encourage its existing municipal and industrial water supply contractors to prepare water use plans for use in allocating only that amount of water needed if sound water management and conservation is practiced. The President's water conservation initiatives contain a similar directive, and Reclamation officials stated that actions were already underway to evaluate present levels of water use to determine where municipal and industrial water may be conserved.

One thing we recognized in each report was that institutional and legal constraints (such as water rights law and the rights of existing contractors) would affect Reclamation's ability to implement recommended changes. Consequently, our current review of the effectiveness of Reclamation's efforts to promote better water management and conservation specifically included addressing the adequacy of Reclamation's consideration of institutional and legal constraints.

RECLAMATION EFFORTS TO PROMOTE BETTER WATER MANAGEMENT AND CONSERVATION

Over the years the Reclamation program has evolved from a primarily single-purpose construction program for developing projects to irrigate croplands and reclaim the arid West to a multipurpose program which includes sophisticated computer-controlled water programs, cloud seeding, and wastewater reuse. The last few years have produced the most rapid

^{1/}"Municipal and Industrial Water Conservation--The Federal Government Could Do More," (CED-78-66, Apr. 3, 1978).

change in land- and water-related resource values, with national emphasis shifting to environmental and social objectives and to better water and energy resources management and conservation.

Several Reclamation programs are designed specifically to promote better water management and conservation. These include:

- Loans to repair, replace, or improve irrigation structures or systems in need of repair or replacement. The loans are authorized under the Rehabilitation and Betterment Act of 1949 (43 U.S.C. 504), as amended, the Small Reclamation Projects Acts of 1956 (43 U.S.C. 422a et seq.), as amended, and the Distribution System Loans Act of July 4, 1955 (43 U.S.C. 421a-h), as amended.
- The Irrigation Management Services program, in operation since 1969, designed to help farmers determine when and in what amounts to irrigate their cropland using a computerized irrigation scheduling service.
- "Total Water Management" studies include the above two efforts and

"* * * involves identification and subsequent implementation of basinwide programs for conservation and improved efficiencies in water management and use, coordinated scheduling of river basin water storage and control works, salvage and reclamation of poor quality supplies, conjunctive use of surface and ground waters, augmentation programs, reallocation of water supplies to higher uses, and all other such practices that promote the fullest and highest use of a basin's water supplies."

At the completion of our review in June 1978, Reclamation had undertaken 10 studies using the total water management concept--estimated to cost about \$15.2 million. These studies were phased in during the period 1972-77 and would not be completed until 1979-81.

SCOPE OF REVIEW

We reviewed Reclamation's policies, procedures, and practices for promoting better water management and conservation, particularly as they relate to Reclamation's total water management program. We also examined reports and correspondence and interviewed officials of the Bureau of

Reclamation; the Department of the Interior's Office of the Solicitor; water user organizations; and State water agencies. We also met with members of two task forces that were established as a result of our prior reports. We made this review primarily at Reclamation headquarters in Washington, D.C., and at Reclamation regional offices in Sacramento, California, and Boise, Idaho.

We met informally with Reclamation and Department officials to discuss our draft report. Their comments were included where appropriate.

CHAPTER 2

RECLAMATION EFFORTS TO PROMOTE BETTER WATER

MANAGEMENT AND CONSERVATION NEED TO

DEAL WITH CONSTRAINTS

Ongoing Reclamation efforts to promote better water management and conservation in the mid-Pacific and Pacific Northwest regions are primarily the total water management studies in (1) the Central Valley project, (2) Upper Snake River, (3) Southwest Idaho, and (4) the Yakima area. All four study efforts can be traced back to problems identified in previous framework and westwide studies which began in the 1960s. In addition, a new study effort known as the Water Conservation Opportunities Study began in 1977.

If actual implementation of study results are used as a measure of success, Reclamation has accomplished little in these two regions so far. Other than carrying out prior study recommendations for more studies, the only goals and work elements that have been completed involve basic data gathering such as the development of ground water computer models and the mapping of existing irrigation systems. The more action-oriented study goals and work elements, concerning the identification of alternative plans for making better use of existing water supplies and the implementation of improved water management practices, have either been the subject of written reports recommending further study or else the goals and work elements have not yet been completed.

Most studies identified certain institutional and legal constraints that affect Reclamation's ability to act. Reclamation officials in both regions stated that they plan either to defer dealing with those constraints until another more specific study level is started or to simply limit their activities to promoting better water management and conservation in those situations where no constraints exist. Such intentions will probably not result in much implementation action for a long time because there are many constraints to the implementation of improved water management practices. Moreover, some opportunities to overcome these constraints may be lost in the meantime before more specific study levels are completed.

Reclamation established the Water Conservation Opportunities Study in 1977 to accelerate the identification of its projects and those of the Bureau of Indian Affairs, where opportunities existed to make more efficient use of water. The initial phase of this study was to rank the

Federal irrigation projects based on opportunities to increase the efficiency and effectiveness of water use. Based on this ranking, higher priority projects were to be selected for further detailed study and subsequent implementation of improvements.

An April 1978 draft report prepared by the study team ranked 46 reclamation projects and 15 projects on Indian reservations. The draft report states that detailed studies costing \$24.7 million would be necessary to implement the identified improvements, and that if all the identified improvements were implemented, water diversions could be reduced in the study areas by 3.3 million acre-feet per year. The total estimated capital costs of making all the identified improvements was \$1.2 billion. Annual benefits were not precisely estimated, but tended to fall below cost for about 70 percent of the study areas, according to the draft report.

The methods used by the study team to evaluate and establish the rankings do not adequately deal with the constraints to the implementation of better water management and conservation improvements. Without adequate recognition of constraints, such as legal and contractual rights to water, adverse effects on other water users, and cost of improvements, we believe the study results can be used properly only to indicate the overall physical opportunities that may be available. Consequently, we caution against using the results of this study for ranking individual projects for future study, where the ranking is based on anything other than the overall physical opportunities that may exist.

REGIONAL STUDY EFFORTS HAVE NOT RESULTED IN
THE IMPLEMENTATION OF IMPROVED WATER
MANAGEMENT PRACTICES AND HAVE NOT DEALT
WITH CONSTRAINTS

The mid-Pacific region has participated in at least three major water resource studies in the past 10 years. These studies were designed to identify water resource problems in the California region and/or to develop alternative ways of dealing with them. The studies are

--"Comprehensive Framework Study--California Region"
(1967-1972),

--"Westwide Study--Critical Water Problems Facing the
Eleven Western States" (1968-1975), and

--"Total Water Management Study--Central Valley Basin"
(1972-1979).

Each study appears to be an outgrowth of the preceding one. For example, the framework study provided the initial data base for the westwide study. In many cases, the westwide study 1/ recommended further study of the same items that the framework study had previously recommended for further study. The total water management study also included many of the same items previously studied in the framework and westwide studies. Following is a schedule showing the solutions or alternatives identified in each study effort which would either increase or improve water supplies.

<u>Solution or alternative</u>	<u>Framework study</u>	<u>Westwide study</u>	<u>Total water management study</u>
Increase yield in normal years by increasing risk in dry years	X		X
Sale of uncontracted water			X
Multiple uses for water	X		X
Water pricing			X
Coordinate operations of Federal and State projects to maximize efficient utilization of water			X
Sale of nonfirm water			X
Weather modification	X	X	X
Watershed management	X	X	X
Water exchange contracts		X	X
Water service curtailment			X
Onfarm water management	X		X
Conjunctive surface/ground water use	X	X	X
Reduce evaporation losses	X	X	X
Construct conveyance systems	X	X	X
Construct storage facilities	X	X	X
Water importation		X	X
Desalination	X	X	X
Improve conveyance efficiency	X	X	X
Wastewater reuse	X	X	X
Geothermal	X	X	

1/The westwide study was originally intended to identify problems and recommend solutions. The study was terminated by the Congress prior to its expected completion. According to Reclamation officials, the resulting report dealt almost exclusively with problem identification.

Although many of the solutions or alternatives described were common to all three studies, the following schedule shows that constraints associated with them were generally not the same. For example, the westwide study showed that the only constraint to weather modification was a technological one. The framework study, on the other hand, identified at least three different ones--financial, legal/institutional, and environmental. While all three studies identified various constraints, none developed ways to deal with them.

<u>Solution or alternative</u>	<u>Constraints identified (note a)</u>		
	<u>Framework study</u>	<u>Westwide study</u>	<u>Total water management study</u>
Increase yield in normal years by increasing risk in dry years			B
Sale of uncontracted water			C, E
Multiple uses for water			A, B
Water pricing			
Coordinate operations of Federal and State projects to maximize efficient utilization of water			A, B, E
Sale of nonfirm water			E
Weather modification	A, B, C	D	B, D
Watershed management		C	B
Water exchange contracts			B
Water service curtailment			B
Onfarm water management			A
Conjunctive surface/ground water use		B	B, E
Reduce evaporation losses	D		
Construct conveyance systems	F	A, C	A, C
Construct storage facilities	F	A	A, C
Water importation			A, B, C
Desalination	A, D	D	A, D
Improve conveyance efficiency		D	A
Wastewater reuse		A, B, C, D, E	A, B, C
Geothermal	F, D	D	

a/Constraints:

- | | |
|-------------------------|---------------------------------|
| A = Financial | D = Technological |
| B = Legal/institutional | E = Coordination of effort |
| C = Environmental | F = Inadequate storage capacity |

According to Reclamation officials, constraints are generally dealt with in detail at the feasibility study level rather than at the appraisal level. They said that Reclamation's three major water management studies in the mid-Pacific region were all appraisal level studies. The Chief of the Planning Division, mid-Pacific region, said that he does not expect many of the solutions or alternatives to progress to the feasibility level from the total water management study. He said that as of June 1978 only one alternative, enlarging Shasta Dam, was going to be proposed for authorization at a feasibility level study effort.

Current Reclamation efforts to promote better water management in the Pacific Northwest Region include total water management studies of the Upper Snake River, Southwest Idaho, and Yakima area. The Upper Snake River and Southwest Idaho studies were preceded by development studies of the Upper Snake River and Southwest Idaho water development projects. Also, all three study areas can be traced back to recommendations in framework and westwide studies.

At one time or another each of the total water management studies in the Pacific Northwest region or the predecessor development studies had as its objective the development of alternative plans for implementing needed conservation enhancement measures. Yet, as of the completion of our review (June 1978) only those study elements involving the development of ground water computer models and the mapping of existing irrigation systems had been completed in the Pacific Northwest region.

According to Reclamation officials, the Pacific Northwest region is not at the point where dealing with the constraints which impede water conservation is the only solution. They stated that there are less painful alternatives, such as opportunities for additional reservoir construction, extensive ground water development, and even interbasin transfers if the citizens desire.

Also, Reclamation officials said that the study efforts will work within the framework of the constraints. They stated most of the constraints to water conservation are the individual State's authority and that Reclamation cannot unilaterally change them. They said, for example, that Reclamation is represented on the Idaho State study team that is developing a comprehensive joint plan for the Pacific Northwest River Basin Commission and the Idaho State water plan. One of the team's tasks is to identify constraints that impede changes in the management of water resources and to recommend changes in State law. Also, since this effort was going on at the same time as the total water management studies, Reclamation did not want to duplicate these efforts.

MAJOR CONSTRAINTS IDENTIFIED BY US

The following five major categories of constraints affect Reclamation efforts to promote better water management and conservation:

- Legal rights to water saved by irrigators.
- High cost and repayment requirements of improving irrigation efficiencies.
- Adverse effects on other water users from water-saving practices.
- Rights of irrigators under long-term contracts which do not provide for adjustments of water rates and quantities.
- Lack of data on the nature and extent of the Federal role for achieving irrigation efficiencies.

Each of these categories are discussed in the sections which follow. Potential solutions to each of these constraints are discussed in chapter 3.

Legal rights to water saved constrains irrigators from seeking improvements

The appropriation doctrine with its "use it or lose it" emphasis provides a substantial constraint to conservation and effective water management. An additional related constraint is the complexity of western water law as applied in 17 different State jurisdictions. State laws and court decisions are extremely complicated, and in some instances it would be very difficult to determine water rights prior to litigation. Thus, an irrigator may be unwilling to commit resources to conserving water in advance of such litigation.

Reclamation law (43 U.S.C. 372) specifically recognizes a major principle of western water law in stating that as to the use of water acquired under provisions of reclamation law "beneficial use shall be the basis, the measure, and the limit of the right."

The Secretary of the Interior, in carrying out the provisions of reclamation law, is required to proceed in conformity with State water laws (43 U.S.C. 383). Under the appropriation doctrine of water law which is prevalent in the 17 Western reclamation States, a water right is acquired by diverting water and applying it to beneficial use. The first person appropriating such water gets

superior rights to the water but does not own it, and the right to appropriate a quantity of water can be lost totally or in part by nonuse.

The exact meaning of beneficial use is not settled. Waste is not a beneficial use of water. Where water is clearly and grossly wasted, this presently may be remedied under State water law by those parties who are directly injured or concerned and, in some cases, by State agencies. As to the economical use of water, Fox v. Ickes, 137 F.2d 30 (D.C. Cir. 1943) states that:

"* * * The economical use of water is far different from its beneficial use. The economical use requires labor, equipment, more efficient ditches, etc. It is often unprofitable because the expense involved is greater than the money returns on the crop will justify. A property right once acquired by the beneficial use of water is not burdened by the obligation of adopting methods of irrigation more expensive than those currently considered reasonably efficient in the locality."

Beneficial use is an issue in cases where an irrigator saves water. In some States, the irrigator who saves water is entitled to the savings, but in other States he is not.

A major change in the laws of those States which do not reward an efficient water user could be a very difficult task involving many different considerations in each State: political and sectional rivalries, downstream versus upstream users, holders of senior rights against junior rights holders, etc. Such changes would have to be made within the framework of the prevailing appropriation doctrine of water law, and the accommodation of a system which developed under relatively simple frontier conditions to the modern complexities of increasing demands for additional uses which must be satisfied from a finite water supply.

The water bank concept discussed in chapter 3 is an alternative not requiring major revision of State water laws.

Cost constraints are considerable but the benefit/repayment relationship is a key to understanding them

Many techniques exist for improving irrigation efficiency. They range in cost and include expensive system improvements such as lining and piping canals and ditches and replacing gravity flow systems with sprinklers and sophisticated drip or trickle irrigation systems. They also

include relatively inexpensive improvements such as irrigation scheduling, which is a systematic determination of when and how much water to apply to crops.

Although cost always is a major factor in any management decision, this factor takes an added significance because of the intricacies of Reclamation's programs and repayment requirements. For example, funds for water conveyance improvements can be borrowed under the Rehabilitation and Betterment Act of 1949, as amended (43 U.S.C. 504); the Distribution Systems Loans Act of July 4, 1955, as amended (43 U.S.C. 421a-h); and the Small Reclamation Projects Act of 1956, as amended (43 U.S.C. 422a, et seq.). Only the latter act provides for grants and they are related to fish and wild-life and public recreation, which are nonreimbursable uses. These laws provide that the loans are to be made to the irrigators upon whose land and for whose benefit the improvements are to be made. Since there is no provision for payment by a third party who might benefit from an improvement, these laws constitute a constraint to an arrangement by which a beneficiary, instead of an owner constructing a system improvement, might pay for it.

In the absence of a firm guarantee of a third party's legal right to saved water, changes in Federal law, providing for a third party obligation, would not appear to be effective. The water bank approach discussed in chapter 3 would also appear to be a feasible solution to this constraint.

Adverse effects on other water users is another uncertainty

There is a large hydrologic interdependence among water users. The water use practices of one irrigator can greatly affect the water use practices of another. For example, if irrigators in the Upper Snake River region in Idaho reduced their seepage rates, they may adversely affect return flows to ground water pumpers and downstream irrigators. While irrigators in the Upper Snake region may benefit from more efficient water use, others may unwillingly have to bear a reduction in their water supplies. The extent that others may have to bear this effect depends on the legal rights of those involved and the ability to trace the actual extent of hydrologic dependence.

The final outcome regarding adverse effects on other water users, like the legal rights situation discussed earlier, will likely be the subject of litigation or State administrative determination on a case-by-case basis. The water banking alternative discussed in chapter 3 may be one way to promote better water management and conservation

without having to go to litigation or extensive State administrative proceedings each time.

Rights of existing water
contractors are difficult to assess
but some are constraints

Reclamation officials stated that long-term contracts with water users prevent them from unilaterally adjusting water rates and decreasing the amounts of water to be provided to further conservation and improved water management opportunities subsequently identified. Reclamation's Pacific Northwest region had approximately 1,500 contracts and an absence of standardized contract provisions concerning better water management and conservation. There are a similar number of contracts in the mid-Pacific region. It is extremely difficult and time consuming to determine which provisions of water contracts would afford conservation and water management opportunities. This circumstance in itself is a substantial constraint to implementation of Reclamation efforts to promote better water management and conservation.

Our limited review of six contracts (three in the Pacific Northwest region and three in the mid-Pacific region) showed that some contractual provisions already exist which can be used to encourage conservation and better water management. Other provisions do not specifically provide for such considerations. Some contracts provide for a set minimum and maximum amount of water based on the continued beneficial use or need for such water. These contracts refer to beneficial use but as previously discussed this concept is not well defined.

One contract examined in the Pacific Northwest region provided for a lesser charge if a smaller amount of water is used or for an increased rate for greater water usage. According to Reclamation officials, conservation-oriented pricing provisions have been used since the 1960s. Mid-Pacific region officials, however, were unaware that such a provision was being used.

Two mid-Pacific region contracts examined provide for rate adjustments every fifth year, which are limited to operations and maintenance, replacement, and power costs. However, each provide for an additional adjustment on specified dates "in accord with the then rate setting policies of the project." Reclamation officials stated that current contracts now only contain the quoted provision which is applicable to all rate adjustments every fifth year. Although there is no specific reference to conservation in the provision, there appears to be no bar to inclusion of

conservation considerations in setting a project's water pricing policy under such a provision.

There are also ways to deal with the constraints imposed by contracts which have fixed pricing and supply terms and which do not allow for adjustments for conservation and water management. The issuance by the Secretary of the Interior of regulations implementing reclamation law, provided those regulations are not directly contrary to existing contractual provisions, may afford such opportunities. It is current Department of the Interior policy that new contracts, including amendatory contracts, interim contracts, etc., should explicitly state that their provisions are subject to any new rules and regulations promulgated after signing the contracts. In this case, future changes in rules and regulations, based on changes in reclamation law, may be made to apply to contracts entered into before promulgation of the rule or regulation changes and before the changes of law were enacted, as well as to subsequent contracts.

Improving the accessibility to pertinent contract provisions and terms and the use of conservation-oriented standard provisions also would have considerable potential for dealing with constraints. These matters are discussed further in chapter 3.

Data is not adequate to show where the Federal effort should focus or how large it should be

Two of our prior reports 1/ showed that reported water losses resulting from inefficient irrigation practices and leaky conveyance systems were substantial. However, because data concerning water use inefficiency and contributory factors were inadequate, the extent and direction of necessary Federal involvement was unclear. This lack of data on the nature and extent of the Federal role is a major constraint that is being reviewed by the Interagency Task Force on Irrigation Efficiencies and the Water Conservation Opportunities Study.

The Interagency Task Force on Irrigation Efficiencies was established in 1977, pursuant to the recommendations in our prior reports. The task force is to develop recommendations

1/ "Better Federal Coordination Needed To Promote More Efficient Farm Irrigation," (RED-76-116, June 22, 1976), and "More and Better Uses Could Be Made of Billions of Gallons of Water by Improving Irrigation Delivery Systems," (CED-77-117, Sept. 2, 1977).

for appropriate Federal objectives, policies, agency roles, and action programs. The current status of the task force's efforts is further described in chapter 3. The Water Conservation Opportunities Study is discussed in the following section.

WATER CONSERVATION OPPORTUNITIES STUDY--A NEW EFFORT THAT SHOULD BE USED WITH CAUTION

In 1977, Reclamation established a Water Conservation Opportunities Study team to identify its projects and those of the Bureau of Indian Affairs where the best opportunities exist to make more efficient use of water. The initial phase of this study was to rank the Federal irrigation projects based on opportunities to increase the efficiency and effectiveness of water use. Based on this ranking, higher priority projects were to be selected for further detailed study and subsequent implementation of improvements.

The April 1978 Water Conservation Opportunities Study draft report states that the studies on which it was based were limited in that they did not fully examine whether any water saved could legally be retained and used by the water user making the improvement or whether such use would adversely affect other water users. It further states that these legal and contractual rights and adverse effects could have a substantial impact but, in view of the time available for study, such impact will have to be more completely evaluated after individual projects are selected for detailed study.

Rankings for the individual projects were made based on 14 evaluative factors that were supposed to include the costs of the measures, the marketability and economic value of the water saved, the relative impact on existing uses, institutional and legal constraints, environmental impacts, and other factors that affect the overall acceptability of the proposal from both a national and local viewpoint. The draft report states that the rankings are best used within each region that participated in the study. Nevertheless, an overall ranking of all 61 projects was included.

We agree with the concept that an inventory or data base should be maintained of projects or water conveyance facilities having, from an overall area or basinwide viewpoint, the best potential of benefiting from improvements. And we agree that this data base should be used in determining which projects or facilities should be encouraged to make improvements. In fact, we made similar recommendations

to the Secretary of the Interior in our September 1977 report. 1/

We disagree, however, with the methods used in the Water Conservation Opportunities Study draft to develop an overall ranking of all 61 projects because the methods do not adequately deal with the constraints to the implementation of better water management and conservation improvements. Without adequately dealing with constraints such as legal and contractual rights to water, adverse effects on other water users, and cost of improvements, the study results can be used properly only as an indicator of the overall physical opportunities that exist. Consequently, we caution against using the results of this study for ranking individual projects to be selected for future study, where the ranking is based on anything other than the overall physical opportunities that may exist.

For example, our review of the five projects selected for study in Reclamation's mid-Pacific region showed that the two highest ranked projects expected to retain most of the water they could save and expected to use the saved water as a hedge against water shortages in dry years. Since this would require water storage capacities that are not available, using the water for this purpose would likely result in water being lost to the ocean during average years. In addition, four of the projects studied reported that the improvements envisioned would have limited effects on other users, but adverse effects outside their service area were not always identified.

The draft report also states that a marketability evaluative factor assumes the water saved would be used by a buyer who is both willing and able to pay the reimbursable costs to produce that water. Four of the five irrigation districts included in the study stated, however, that they completed the pertinent questionnaire under the assumption that grants would be available to pay for the improvements.

For instance, the Orland project, which ranked second in the mid-Pacific region and eighth of all 61 projects studied, was reported as being able to reduce its water requirements 64,100 acre-feet annually through the prevention of seepage losses, capture of return flows, and changes in the methods of onfarm water application. The estimated cost of making these improvements was reported as \$47.9 million.

1/"More and Better Uses Could Be Made Of Billions Of Gallons Of Water By Improving Irrigation Delivery Systems," (CED-77-117, Sept. 2, 1977).

Orland Water User Association officials told us that they could use 4,000 acre-feet of the saved water to irrigate another 1,300 acres in the district, and the remaining 60,100 acre-feet would be held in storage as a hedge against water shortages in dry years. But storage of the saved water presents a problem because in about 2 years the reservoirs serving the Association would be filled to capacity. Once that occurs there would be no room for subsequent winter runoff, and water which previously was captured would have to be released downstream.

Reclamation officials agreed with our analysis. They said the Association has the right to any water it can conserve but that which it cannot control would be available for downstream use. They cautioned, however, that uncontrolled water would occur generally during the winter months, and any such water from the Orland Project would end up in the Sacramento River at a time when the river already contains more water than can be diverted from the Sacramento-San Joaquin Delta. In other words, the saved water, which could cost \$47.9 million to save, would, in effect, run out into the ocean rather than be put to beneficial use.

Reclamation officials also said that the reported improvements could adversely affect at least two other water districts, the town of Orland, and numerous other users who depend on ground water. They said that the water which is now not consumed by the Association recharges the ground water aquifers used by the others outside the Association.

Regarding the repayment of the cost of the improvements, Association officials stated that they would not be in favor of the improvements unless they were funded through grants. They said that a \$2.5 million loan was disapproved during the drought because the members did not think the benefits of extra water during years of short supply would justify the loan repayment requirements.

The Langell Valley irrigation district Klamath project is another irrigation district that envisions retaining the water reported as being able to be saved (32,000 acre-feet). Like Orland, this project does not have adequate storage facilities to capture the saved water, the water saved would have adverse effects on water users outside the irrigation district, and the district would not favor the improvement unless its cost (\$10.5 million) was funded through a grant. Langell Valley ranked first in the mid-Pacific region and second of all the 61 projects studied in the Water Conservation Opportunities Study.

RECOMMENDATION TO THE
SECRETARY OF THE INTERIOR

We recommend that the Secretary of the Interior direct the Bureau of Reclamation to deal with constraints in all ongoing and future study efforts, including those where more than one phase of study is required.

CHAPTER 3

POTENTIAL SOLUTIONS FOR OVERCOMING CONSTRAINTS TO THE IMPLEMENTATION OF IMPROVED WATER MANAGEMENT PRACTICES

Three different potential solutions have been identified for dealing with the constraints discussed in chapter 2. These potential solutions, which we believe need to be further studied by Reclamation, are (1) water banking, (2) consideration of basinwide benefits resulting from improving irrigation systems in Reclamation loan determinations for such improvements, and (3) improvements of access to contract terms and development of conservation-oriented standard contract language.

The ongoing Interagency Task Force on Irrigation Efficiencies plans to recommend objectives, policies, roles, and action programs for Federal, State, and private interests that deal with the problems of inefficient irrigation systems. Consequently, we believe that the amount of resources committed to the examination of the potential solutions discussed in this chapter and to other Reclamation studies of irrigation water management and conservation should be based on the results of the task force's efforts, if the task force accomplishes its goals. Thus far a June 1978 draft report by the task force's Technical Work Group contains information on the overall significance of the irrigation efficiency problem but does not adequately address the basic causes and applicable Federal role.

WATER BANKING--A WAY TO OVERCOME LEGAL AND COST CONSTRAINTS

Water banking ^{1/} is a concept which appears to have potential for overcoming constraints concerning (1) the legal right to conserved water (i.e., the "use it or lose it" syndrome), (2) the adverse effects on other water users, and (3) the cost of improvements. Reclamation currently is not using a water bank, but it successfully used a form of water banking during the 1976-77 California drought.

^{1/}The water banking concept is discussed in greater detail in a January 1978 report, "Water Banking: How to Stop Wasting Agricultural Water," by Sotirios Angelides and Eugene Bardach of the Institute for Contemporary Studies, San Francisco, California.

Reclamation officials generally agreed that such a concept has merit and needs to be further studied.

What is water banking and why have we not seen much of it before?

Water banking is a concept which would allow water users to temporarily transfer some or all of their water rights to other users. It basically involves the purchase of water from those who have more water than they need by an intermediary or broker and the sale of that water to those who need it.

Such transfers have not taken place to any great extent in the past mainly because State water codes do not readily permit water to be temporarily transferred from one user to another, even though historically water rights allocations may have resulted in some users having the right to more water than they could use. The largest barrier to such transfers is probably the beneficial use doctrine, which limits water rights to an amount reasonably required for beneficial use.

Although the beneficial use doctrine was originally intended to limit the waste of water it now has the opposite effect--it gives irrigators the incentive to use as much of their water as possible to protect themselves from future legal disputes. In water rights disputes, local custom and long continued use of a given quantity of water shows whether or not the doctrine has been complied with. Consequently, a temporary transfer of water rights might be used to show that such water was not being beneficially used by the seller.

In addition to the beneficial use doctrine, some State water codes also prohibit water districts from transferring water outside their boundaries unless the water is surplus. Surplus water has been defined as water that is unusable, at any price, by other members of the district. Proving that water is surplus is very difficult. Further, many districts themselves are set up to preclude reallocation of water between members once the initial allocation is made.

The effects of water transfers on third parties is another serious and difficult constraint to deal with in transferring water from one user to another. Water transfers can adversely affect other water users in several ways. For example, if an irrigator transfers water to another user rather than applies it to the land, the irrigator has eliminated any return flows or ground water recharge that a neighbor may have historically relied upon. Another example of effects on third parties would be a

case where upstream users transfer their surface water supply and replace it with ground water. If their increased pumping causes the level of water in the basin's underground aquifer to lower, it could cause the downstream user to have to spend more for energy to pump water. It could possibly deplete some ground water aquifers, leaving those affected with no water source.

Another constraint to water transfers is the lack of a broker or intermediary to bring a buyer and seller together. Negotiating a transfer, recordkeeping, etc., also cost money. Currently there is no system whereby a seller can make known his intentions not to use his water and find a buyer willing to take it.

Water banking is not a new concept

During the 1976-77 California drought, both the State Department of Water Resources and Reclamation operated kinds of temporary water banks which were quite successful.

The State's effort helped save irrigators in the San Joaquin Valley and municipal users in northern California from disaster. The Department of Water Resources bought water from the Metropolitan Water District in southern California, water which was still stored in the San Joaquin Valley and awaiting transportation south. Metropolitan was able to satisfy its needs by use of Colorado River water from Reclamation's Boulder Canyon project.

While the State was able to get water from an area that had another supply source, Reclamation got the water for its water bank from irrigators who chose to sell their water rather than grow crops. Reclamation bought some of its water under the Drought Emergency Act from California rice growers, who traditionally use a lot of water. Because of anticipated low prices for rice, the growers chose not to plant, making water available to the Bureau for those who were in danger of losing perennial crops (such as orchards and vineyards).

Implementation of a water banking program

A water bank could operate similarly to a financial bank. An irrigator with water in excess of his current needs could temporarily deposit or sell his water rights to an intermediary or water bank, who would in turn make the water rights available for withdrawal or sale to an irrigator who needs it. Unlike a financial bank, water is not stored in the intermediary's water bank but, rather, the water is left in its own storage reservoir or facility. Once the broker finds a buyer for the water, it is scheduled for delivery from its storage point.

Recordkeeping, scheduling, and coordination are essential to a water banking program. Also, all transactions must be conducted during a given year. While the buyer and seller can reach long-term agreements on an annual amount of water, a water bank cannot carry water over to the subsequent year. To do so would require off-stream storage and other related facilities whose cost would probably be prohibitive.

The price of water under the water bank arrangement could be determined in the marketplace. It could basically be set by the economic forces of supply and demand and would be influenced by factors such as the anticipated prices for agricultural products and the need for and the availability of money. The sale price of the water could be based on its market value plus transportation and administration costs.

In order for Reclamation or a State water resources agency to implement a water banking program, State water codes would not have to be completely revised. Instead, the State legislature could amend the beneficial use doctrine to include water banking as a beneficial use. ^{1/} Further, they could allow each water agency in the State to operate a water bank if it chose to do so. With these changes, the fear of losing one's water rights through nonuse would be eliminated. For example, an irrigator who traditionally uses his total water supply, even though he does not need it but fearing he might lose his right to it, could, under this proposal, sell the water he does not need.

As discussed earlier, transferring water can have adverse effects on other water users who historically have relied on the irrigators' runoff. One way to deal with this conflict would be to provide compensation to those adversely affected. Compensation could be in cash or in the form of a credit should the affected third party choose to participate in a water banking transaction.

The compensation to adversely affected third parties could be added to the price the bank would pay for the water, including administrative and transportation costs. If these costs amount to more than the potential buyer is willing to pay the transaction would not take place, the third party

^{1/} In June 1977 the Idaho legislature passed a resolution agreeing, in principle, that a water bank should be established. According to a State official, in January 1979 a legislative committee will prepare a bill to establish a water bank and to make water banking a beneficial use of water.

would not be compensated, and the bank would not buy the water.

Water agencies choosing to participate in the water banking program could develop and administer it without major institutional changes. The administrative costs would be borne by the proposed water buyers. The program need not require public funding.

In addition to making it easier for water users to transfer their water rights, water banking provides an excellent incentive for irrigators to promote and practice water conservation. If an irrigator knows he can sell any water in excess of needs he will probably tend to reduce use to that necessary to grow crops.

Further, water banking could encourage irrigators to repair or replace leaky conveyance systems. Irrigators, whose conveyance systems are in disrepair and/or inadequate, have no incentive to spend large sums of money to repair them--especially if they do not need the water they could conserve. Under the water banking concept, irrigators might repair their systems if they can recover their initial investment in a reasonable amount of time through the sale of the conserved water.

Reclamation officials in Washington and the mid-Pacific region have commented favorably on this concept. However, both expressed some reservations regarding its implementation.

The Assistant Commissioner commented that Reclamation is in favor of the water banking concept and its associated water conservation potential, but is limited in participation by reclamation law, particularly by residency requirements. He also commented that time-consuming and costly environmental impact statements may have to be prepared for each transaction, that there could be a substantial administrative problem created by the need to identify and compensate injured third parties, and that sellers using the water bank may get a windfall benefit.

The mid-Pacific region thought that the concept had a great deal of merit, but also expressed some reservations concerning its implementation. The region's main concern was that the concept has the potential for adding or substituting a complex program to the already complicated system of water allocation in California.

We believe that Reclamation should consider the application of a water banking concept in its Federal service

areas. We do not envision Reclamation implementing such a program for all projects in the 17 Western States. However, we feel that Reclamation should include such a program in its options or alternatives for promoting water conservation. It is possible that in some areas the concept would have merit and in others it may not. It may be that some form of this concept could be tailored to meet Reclamation's specific needs.

INCLUDING CERTAIN BASINWIDE BENEFITS
IN RECLAMATION LOAN DETERMINATIONS ALSO
COULD OVERCOME COST CONSTRAINTS

Reclamation loans to improve or replace inefficient irrigation systems are approved primarily by the applicant's ability to repay them. They are granted to individual water districts with little consideration to the basinwide effects of the improvements. Consequently, basinwide benefits such as energy savings will not be considered in approving Reclamation loans unless they happen to increase the applicant's ability to pay. These benefits can occur when energy is saved by better controlling surface water and not allowing it to seep into the ground where it would have to be pumped to the surface by another water user.

Several recent reports show that better control of surface water can significantly affect the amount of energy consumed. Generally, greater irrigation efficiency results in energy savings, but in some cases can result in greater energy requirements.

For example, a 1977 report ^{1/} by the Agricultural Research Service states that irrigation is an energy intensive practice requiring an equivalent of about 47 million barrels of crude oil each year. Since energy is required to lift, transport, and distribute water, the report states that any improvement in the efficiency of the system translates directly into energy savings. The report also states that some improvements, such as switching from gravity to sprinkler irrigation systems (with its higher pressure requirement) can increase energy requirements.

At the completion of our review in June 1978, the University of California at Davis was developing guidelines to assist decisionmakers in evaluating the effects on energy and water of various changes in irrigation systems and

^{1/}"Potential For Saving Energy In Irrigation," Agricultural Research Service, U.S. Department of Agriculture.

practices. Reclamation officials in the mid-Pacific region are aware of the study and are monitoring its progress.

We believe that if basinwide benefits such as energy savings outside the water district are considered in approving improvement loans, some loans which otherwise were not justified might be able to be approved. Further study of this matter may be able to justify cost-sharing arrangements with the true beneficiary or changes in reclamation law whereby a portion of repayment is waived in the national interest.

Reclamation officials agreed with our findings. They said that other basinwide benefits also should be considered (such as improved water quality, fish and wildlife, recreation, and flood control).

IMPROVING ACCESS TO CONTRACT
TERMS AND DEVELOPING CONSERVATION-
ORIENTED STANDARD CONTRACT LANGUAGE
COULD OVERCOME SOME CONTRACTUAL CONSTRAINTS

Reclamation's mid-Pacific and Pacific Northwest regions each had about 1,500 outstanding contracts. Neither region had developed much in the way of conservation-oriented standard contract clauses nor had they received any from Bureau headquarters. Consequently, it is extremely difficult to determine which water contracts offer better water management and conservation opportunities.

Although each contract is examined thoroughly when it is reviewed or amended, a system providing easy access to pertinent terms and provisions is not available to management for use in determining what conservation-oriented language can be added and for developing overall Reclamation policy. Also, as discussed previously in the section on constraints, one of the contracts we examined in Reclamation's Pacific Northwest region contained a pricing provision aimed at encouraging less use of water. According to Reclamation officials in that region, this conservation-oriented pricing provision had been used in all applicable contracts since the 1960s. Mid-Pacific region officials, however, were unaware that such a provision was being or could be used, indicating a need for standardization.

In July 1972 all Reclamation regional directors were asked to comment on a proposal concerning the desirability of, and possible procedures for, establishing an automated contract data system. Although the proposal was designed to accumulate a broad spectrum of data, information on water rate and quantity provisions was to be included.

Essentially, the comments of the regional directors were very favorable toward the proposal. Adverse comments generally concerned the cost and personnel required to run such a system. Reclamation officials stated that the lack of funds and people eventually stopped implementation of the proposal.

We believe that further study of this or a similar proposal is warranted, particularly in view of the recent Reclamation emphasis on promoting better water management and conservation. Even if an automated data system is not developed, we still believe that conservation-oriented standard contract language should be developed and provided for use by Reclamation's regional offices. Although Reclamation officials believe that these types of contract provisions must be developed on a case-by-case basis to serve the interests of both contractual parties, we believe that various models of standard contract language should be provided. These models could be modified, as necessary, to meet specific situations.

INTERAGENCY TASK FORCE ON
IRRIGATION EFFICIENCIES--
A NEEDED CONTRIBUTION IF IT
ACCOMPLISHES ITS GOALS

The Interagency Task Force on Irrigation Efficiencies will perform a very useful service if it can determine the significance of inefficient irrigation practices and if it addresses the basic causes of those practices. If the task force meets its objectives, the extent and direction of the Federal involvement should be quite clear. Then Federal agencies such as Reclamation will better know how much resources to commit to its efforts and where they should be committed. This knowledge is essential to the successful implementation of current and future Reclamation study efforts as well the potential solutions to overcoming constraints discussed previously.

In 1977, representatives from the Bureau of Reclamation, the Soil Conservation Service, and the Environmental Protection Agency formed the Interagency Task Force on Irrigation Efficiencies under the lead of the Department of the Interior to examine the problem of inefficient irrigation. This task force was established as a result of recommendations contained in our two prior reports. 1/

1/"Better Federal Coordination Needed to Promote More Efficient Farm Irrigation," (RED-76-116, June 22, 1976), and "More and Better Uses Could be Made of Billions of Gallons of Water By Improving Irrigation Delivery Systems," (CED-77-117, Sept. 2, 1977).

The reports recommended that the pertinent Federal agencies should (1) determine the causes of over irrigation and the extent each contributes to the problem, (2) identify ways to improve inefficient irrigation delivery systems and determine the overall basinwide effects of such improvements, and (3) determine the role the Government should play in improving irrigation and delivery system efficiencies.

The task force established a Technical Work Group to identify irrigation water use and management problems and to recommend objectives, policies, roles, and action programs for Federal, State, and private interests to address such problems. The Technical Work Group issued a draft report in June 1978 and plans to issue the final report in May 1979. Thus far the draft report contains information on the overall significance of the problem but does not adequately address the basic causes and the applicable Federal role.

The draft report devoted considerable effort to quantifying the amounts of water that could be saved by improving inefficient onfarm and off-farm irrigation systems. The draft report presented the results of a Soil Conservation Service study that showed total water diversions could be reduced by about 39 million acre-feet in the 17 Western States. It was estimated that about 8 million acre-feet of the reduction were actually attainable water savings.

The draft report also showed where in the 17 Western States these savings could be attained as well as the associated costs. The total one-time cost for necessary system improvements was estimated to be \$14.6 billion. Of this amount \$6.2 billion was for off-farm improvements and \$8.4 billion for onfarm improvements.

In its present form, the draft report does not adequately address the causes of inefficient irrigation practices nor the role the Government should play in resolving the problem. For example, our June 1976 report identified five major causes of inefficient onfarm irrigation practices, and we recommended that the appropriate Federal agencies determine the extent each contributes to overirrigation. These causes were

- low cost of irrigation water;
- inaccurate estimates as to how much and how often to irrigate;
- fears that water rights would be reduced if entire entitlement was not used;

--uncertainty about future water supplies; and

--human factors, including traditions and customs, personal preferences, and motivation.

The draft report discussed several of the causes outlined above but did not determine the extent each contributes to overirrigation. For example, regarding the fears that water rights might be lost, the draft report mentioned only that under existing laws and court decrees irrigators often use their total entitlement of water, even if inefficiently, rather than lose the right to divert water. Concerning inaccurate estimates as to how much water to apply and when, the draft report acknowledged that such practices are a cause of overirrigation. The draft report stated that the amount of water inefficiently used due to improper timing of irrigation, incorrect application amounts, and poor water control can be reduced if irrigators match plant needs. It concluded that to avoid such losses an irrigator needs an irrigation system capable of uniform and efficient water application at the time irrigation is needed. In both examples the draft report merely recognized that the causes exist even though their existence has been known for years.

Reclamation officials stated--as they had stated in reply to our 1976 report--that they doubted whether it would be practicable to undertake more than a general or qualitative assessment of the extent specific causes contribute to inefficient irrigation systems. They said that because the causes are complex and interrelated they have considered it best to proceed with general assessments of the extent specific causes contribute and devote most of the available resources to evaluating alternative measures for increasing water use efficiencies as to their cost effectiveness and viability.

While we agree that the cost effectiveness and viability of alternative methods for increasing water use efficiencies will have to be examined, we believe that some form of quantitative data showing the extent each cause contributes to the problem will be needed to be sure that effectiveness is adequately evaluated. Some form of quantitative data on the significance of the individual causes--obtained on a test basis, through the use of a user needs survey, or otherwise--would make it easier to identify the Federal actions that are necessary to respond to the problem. In other words, should the Government's role be directed at improving its pricing policies or will it be more effective to help farmers determine when and how much water to apply to their crops? Should water rights solutions be sought or are education programs more important? These are the types of

questions on effectiveness that could be better answered if some form of quantitative data was available on the extent the individual cause contributes to overirrigation.

RECOMMENDATIONS TO THE
SECRETARY OF THE INTERIOR

To strengthen the Bureau of Reclamation's efforts to promote better water management and conservation, we recommend that the Secretary of the Interior direct the Bureau of Reclamation to examine each of the following potential solutions for overcoming constraints to the implementation of improved water use practices:

--Water banking.

--Consideration of basinwide benefits resulting from improving irrigation systems in Reclamation loan determinations for such improvements.

--Improvement of access to contract terms and development of conservation-oriented standard contract language.

We also recommend that the amount of resources committed to these examinations and to Reclamation's studies of irrigation water management and conservation should be based on the results of the study by the Interagency Task Force on Irrigation Efficiencies. Steps also should be taken by Interior to assure that the final report of this task force adequately addresses the basic causes of irrigation inefficiencies and the applicable Federal role.

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